Desert View Power

Economizer Discovery Work – 2020 Fall Outage

Update: November 18, 2020

Safety Statement

Despite the complex and challenging nature of the events described below, there have been no accidents to date. One contractor developed symptoms and tested positive for COVID-19 after leaving the site on November 9. The contractor's affected crews have been notified and additional actions are being taken to reduce exposure.

Executive Summary

Unit 2 was shut down for the Fall Outage at 12am on Nov 8th. During the inspection that day, DVP discovered several upper economizer hangers had broken and the associated economizer pendants had dropped below the other fixed pendants. The plant is in the process of making repairs, with an expected online date of 11/30 (planned return was 11/16). Root cause analysis is ongoing, and insurance has been engaged to determine if the event is covered. Property damage has a $500k deductible (repair cost expected around $1M), and Business Interruption has a wait period of 45 days (unlikely to trigger). Expected impact to EBITDA is $1.55M, details below. The current plan is to return the unit to operating status by repairing the existing economizer and gather data to assess its remaining useful life. With a PPA extension, several projects have already been identified to shift the heat duty back to the combustor, lower overall temperature and erosion, and reduce the tube leaks in the backpass.

Impact due to economizer failure

Economizer repair cost	$	982
Gross profit	$	565
EBITDA impact	$	1,547

Updated financial forecast

Full Year, pre-economizer			Full Year, pre-economizer		
Budget	Actual + Forecast	Fav/(unfav) Variance	Budget	Actual + Forecast	Fav/(unfav) Variance
$ 9,947	$ 8,040	$ (1,907)	$ 9,947	$ 6,493	$ (3,454)

Discovery Details & Timeline

Desert View's Fall Outage was scheduled for November 1-16, with Unit 1 offline 11/1-11/9 and Unit 2 offline 11/8-11/16. Overlap between the units allowed for work on the steam turbine governor valve and fuel handling systems that are common to both boilers. Unit 1 returned to service at 0024 on November 10.

The Unit 2 backpass was inspected from door 3 on the day shift of Nov 8th. This initial inspection revealed several upper economizer hangers had broken and the associated economizer pendants had dropped below the other fixed pendants. This was also confirmed by viewing the pendants thru door 1. This unit requires at least 30-36 hours of cooldown before entry can be made. Entry was made on Nov 9th. The extent of the damage couldn't be determined until the superheater tube banks and economizer tube banks could be water washed. During the super heater wash the economizer tube banks started collecting water in the lanes. This indicated there was excessive ash fouling in the lanes holding the water. At this point it was determined the economizer would need to be washed first to remove this extra weight. In order to complete the wash safely, the north and south SCE membrane needed to be removed to access the lanes. This started on Nov 10th. The water wash in the economizer took ~2 days to complete. Once completed, the wash team returned to the superheater and finished the wash. Entry was first made for a thorough inspection on Nov 12th. Most of the pendants that had failed were in the center of the bundle. All 51 pendants were rigged into place at the upper economizer headers to make it safe to enter doors 1 & 2 for further inspection. A plan was made to install a platform in door 1 to cut the pendants loose and pull them apart. Once this was completed, further damage was identified on the bottom alignment bars at the bottom of each upper and lower economizer dropped pendants. This damage was communicated to GLP for further guidance.

Unit 2 is currently estimated to return to service on November 30th. Updates to the schedule will be provided as available.

Root Cause Analysis (Preliminary)

Root cause efforts are ongoing, but preliminary observations indicate multiple factors may be at play:

- **Erosion**: Hanger plates and straps are eroded in some sections. These are the load-bearing members that support the economizer pendants.
- **Improper prior repairs**: Prior repairs on hanger straps ("J-hooks") caused all weight to hang from a single point vs. original design that distributed the weight more.
- **Operating conditions**: Higher temperatures in backpass, increased ash loading due to online water washes. Significant misalignment in upper economizer, smaller lane spacing in economizers compared to SH's (3.5" vs 4.5"), along with online wash likely contributed to heavier fouling in upper economizer
- **Other possibilities**: Inadequate design (requires additional engineering review); corrosion (unlikely at this temp range); elongation/deformation of hanger plates (unlikely with weight); inferior materials used in previously replaced hanger systems (certain Inconel devices were replaced with 304 & 310 SS)

DVP will gather samples of failed components (hangers, tubes, hanger plates, etc.) to send off for material analysis to help determine failure mechanisms.

Path Forward

Short term

DVP is working to repair the economizer and return Unit 2 to service as expeditiously as possible. Brahma's labor is the critical path; materials have been identified and 90+% of required items should be onsite by November 17.

While down, DVP will perform UT analysis of the upper and lower economizer pendants where exposed and within reach to determine the current condition and useful remaining life of the equipment. Minimum required service life is April 2022 (end of current PPA term). DVP will work with the NDT company and Brahma to target areas that show risk of not achieving that service life.

Long term

Without a PPA, the plant needs to operate until April 2022. DVP is monitoring the effectiveness of the online water washing to ensure the process cleans the unit without inducing tube leaks. The plant will monitor this carefully, and will delay further washes until Unit 1 economizer has been inspected for similar hanger issues.

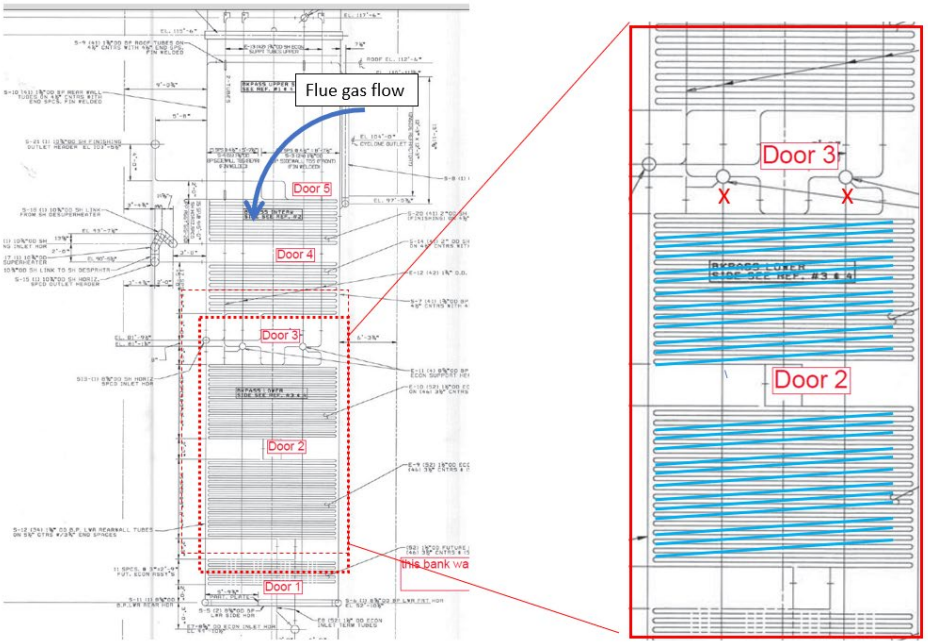
With a PPA renewal, DVP will

1) Use the UT analysis to plan capital replacements, with an earliest targeted replacement date of 2022. With the scope and expected lead times for an economizer, decisions will likely need to be made Q2/Q3 of 2021.
2) Evaluate capital improvements necessary to move the heat duty from the backpass to the combustor (i.e., back to design). Key project is the vortex finder/cyclone modifications that were included in the 2021 budget proposal. Reducing the combustion temperatures from the combustor to the baghouse is critical to the long-term successful performance of the boilers. The positive effects are cascading and will reduce maintenance (heat stress, erosion, etc.) and efficiency (restore the HP feedwater heater to service, etc.).
3) Target other areas of improvement that could possibly extend the life of the current economizer tubes or reduce future leaks, including a new steam cooled enclosure wall, better online wash strategy, improved fuel quality, etc.

DVP is requesting approval to proceed with unbudgeted repairs to return Unit 2 to service as quickly as possible. The current estimate is approximately $1M; the plant will provide updates as available. Greenleaf expects to be able to fund the repairs out of the project reserves in order to maintain adequate operating cash (up to $1M) at year-end

Appendix – Photos

Side-view of backpass



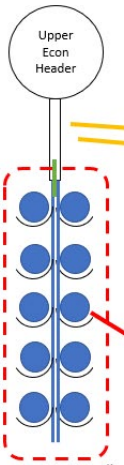
Northern end of tubes have fallen, ranging from a few inches to 4 feet.

Southern section appears to only have moved inches.

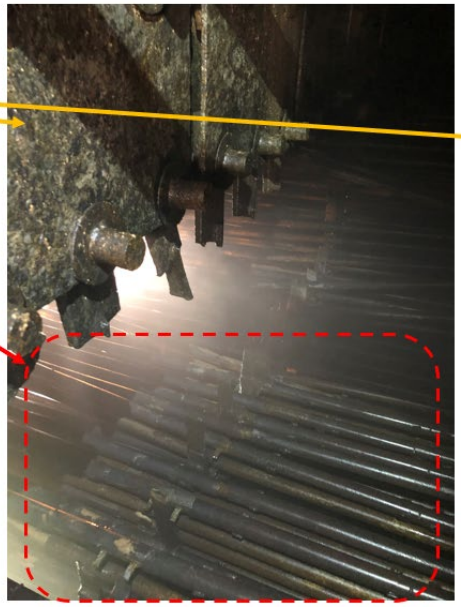
Lower economizer is supported by upper, so both have dropped.

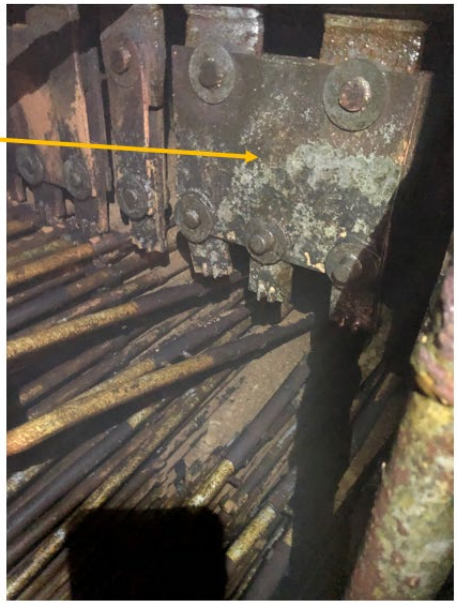
Top of upper economizer looking NW. Note broken straps in foreground. Tubes fell as much as 4 ft in this section. 24 pendants of the 51 fell.

Top of upper economizer looking SE. Broken straps here too, most only fell inches.



Top econ. Has "J hook"-style tube hangers. Top of J-hook welds to plate that is welded to bottom of header. The weld and/or plate failed.





Eroded hanger strap components that failed